

PROTOTYPE DESIGN for GLOBAL SEED BANK NETWORK

ARCH 523 Masters Project Preparation
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LIST OF CONTENTS

ABOUT THE PROJECT ----- 4

- About the project
- Global Warming - What is going to happen?
- Case statement
- Seed bank network
- Stake holders

CASE STUDIES ----- 9

- Existing seed banks
- Millennium Seed Bank Project
- Svalbard Global Seed Vault
- Eden Project
- The Seed Cathedral
- Institute of the Botanical Garden of Barcelona
- Edf Archives Center

SITE ----- 4

- Site Selection Criterias
 - Geographical changes
 - Economic conditions
 - Plant diversity
- Proposed network diagram

PROGRAM ----- 28

PLACE HOLDER ----- 4

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REFERENCES ----- 9



ABOUT THE PROJECT

ABOUT THE PROJECT

A SIMPLE IDENTIFIER:

My project will be a prototype of seed banks.

A SHORT DESCRIPTION:

My project will be about a network of banks/research centers **conserving genetic information of plants**, and researching possibilities of re-production and climate adjustment.

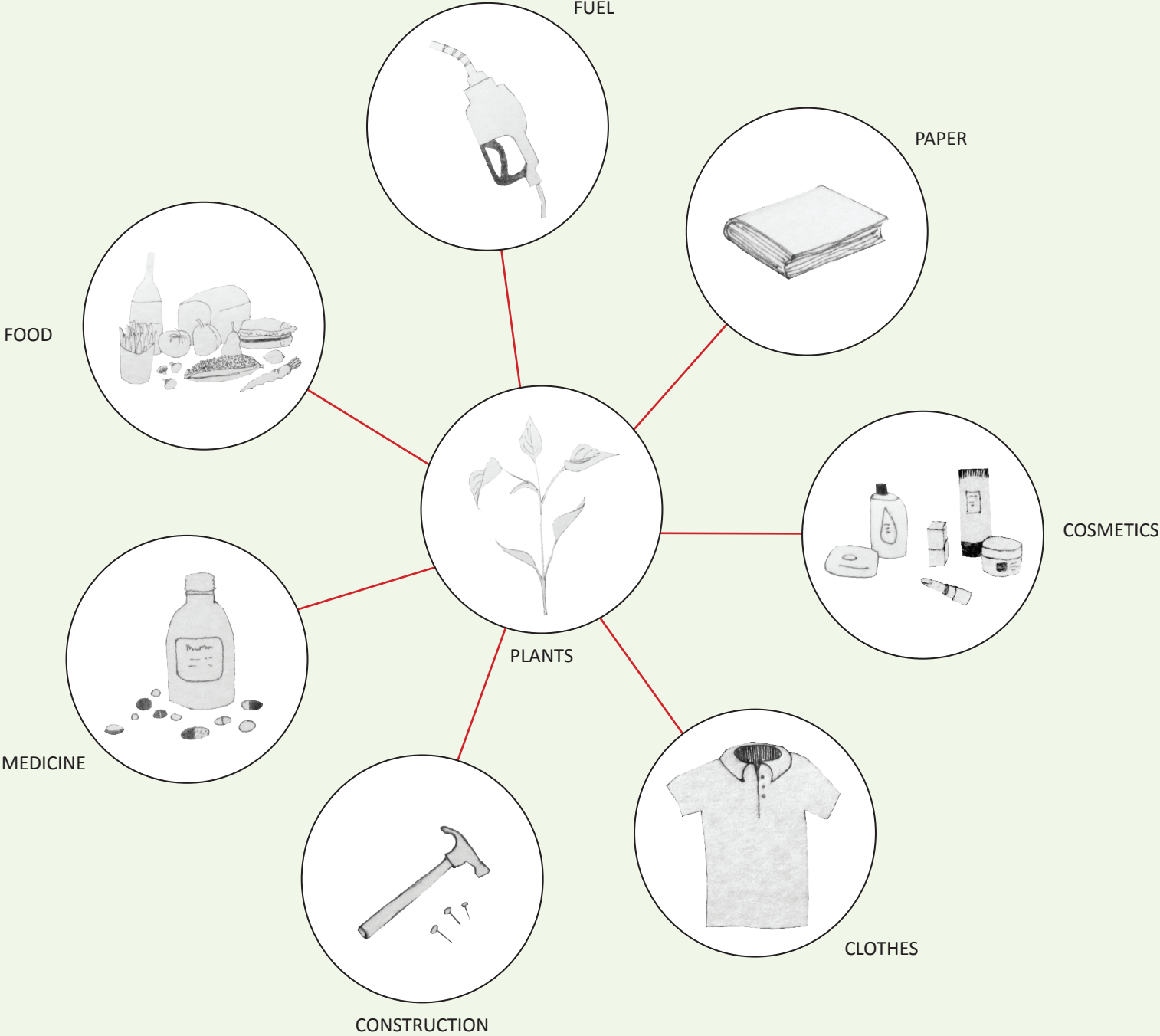
A POINTED CASE STATEMENT:

My project will be developed because due to **climate change** a lot of plant species are in **danger of extinction**. As scientists assume, Arctic ice might totally disappear by 2040, which will, of course, cause the changes in water level and therefore, flood a large part of the Earth. They also assume, that by 2070 the lowest temperature will be the highest temperature any plants have ever experienced. So what happens to plants in such case becomes obvious - they die out; this will cause a chain reaction of fauna extinction, since they will have neither shelter nor food.

My project would be a prototype of seed bank for a **global network** spread throughout the world. I would like to propose locations for multifunctional centers in certain countries, which would be supplied by sub-centers located in others based on long term climate and economic predictions, as well as plant hardiness zones. The prototype building will be a **modular structure**, allowing each country to **select functions and size** appropriate to them.

The building will include seed storages and labs, where groups of scientists would register and dry collected seeds, then conserve and reproduce them; they will modify plants genetically to help them adjust to new climate conditions. The facility will also include educational facilities to help **rise public awareness** and temporary accommodation for travelling scientists.

PLANTS & HUMANS



PLANTS, HUMANS & GLOBAL WARMING

RESULTS OF GLOBAL WARMING:

- **Glaciers could melt**, causing sea levels to rise while creating water shortages in regions dependent on runoff for fresh water.
- **Sea level could rise** 7 - 23 inches (18 - 59 cm) by century's end. Rises of just 4 inches (10 centimeters) could flood many South Seas islands and swamp large parts of Southeast Asia.
- Strong hurricanes, droughts, heat waves, wildfires, and other **natural disasters** in many parts of the world.
- **The growth of deserts** may cause **food shortages**.
- More than a million species face **extinction** from disappearing habitat, changing ecosystems, and acidifying oceans.
- The ocean's circulation system (ocean conveyor belt) permanently altered, causing a **mini-ice age in Western Europe** and other rapid changes.
- **Positive feedback effect** - rising temperatures could release additional greenhouse gases by unlocking methane in permafrost and undersea deposits, freeing carbon trapped in sea ice, and causing increased evaporation of water."

"Now **plants are under threat**. They are under threat because of the changing climate. And they are also under threat because they are sharing a planet with people like us. And people like us want to do things that destroy plants and their habitats. And whether it is because of the food production or the introduction of alien plants into places where they really oughtn't be, or because of habitats being used for other purposes, all these things are meaning that plants have to adapt, or die, or move. And plants sometimes find it rather difficult to move, because there might be cities or other things on the way.

So if all human life depends on plants, doesn't it makes sense that perhaps we should try to save them?!"

(Johnathan Drori)

Source: National Geographic News. *Global Warming Fast Facts*. Updated 14 June 2007. News.National-Geographic.com. <http://news.nationalgeographic.com/news/2004/12/1206_041206_global_warming.html>

* Source: Drori, Johnathan. Why we're storing billions of seeds. TED Talk. Web. Filmed Feb 2009. Posted May 2009. <http://www.ted.com/talks/jonathan_drori_why_we_re_storing_billions_of_seeds.html?ga_source=embed&ga_medium=embed&ga_campaign=embed>

PROJECT GOALS

The idea is important because...

life on the entire earth depends on plants. The results of global warming might be much more destructive in long term than a lot of people believe; once we lose species of live organisms without a trace, we might never get them back. And it is not just the specific species we lose, but the entire chain reaction tied to it.

Since the problem is global, it should be solved globally by **connecting all the resources** of the world.

The project will solve...

issues of plant species extinction caused by global warming.

The project will be successful...

by creating not only one or two centers for plant preservation, but by designing entire system, a **network of intellect and effort** of the world to fight for the green.

POTENTIAL DESIGN RESPONSES:

- Creating a **net of genetic centers** in different parts of the world according to economical, political and environmental stability.
- Designing a **prototype** building which could work in different climate, seismic and nuclear conditions with the same success.
- Designing a flexible modular **system** allowing the countries “pick up” desirable functions and scale of a seed bank.
- Making the building as much **off-grid** and sustainable as possible.

CASE STATEMENT

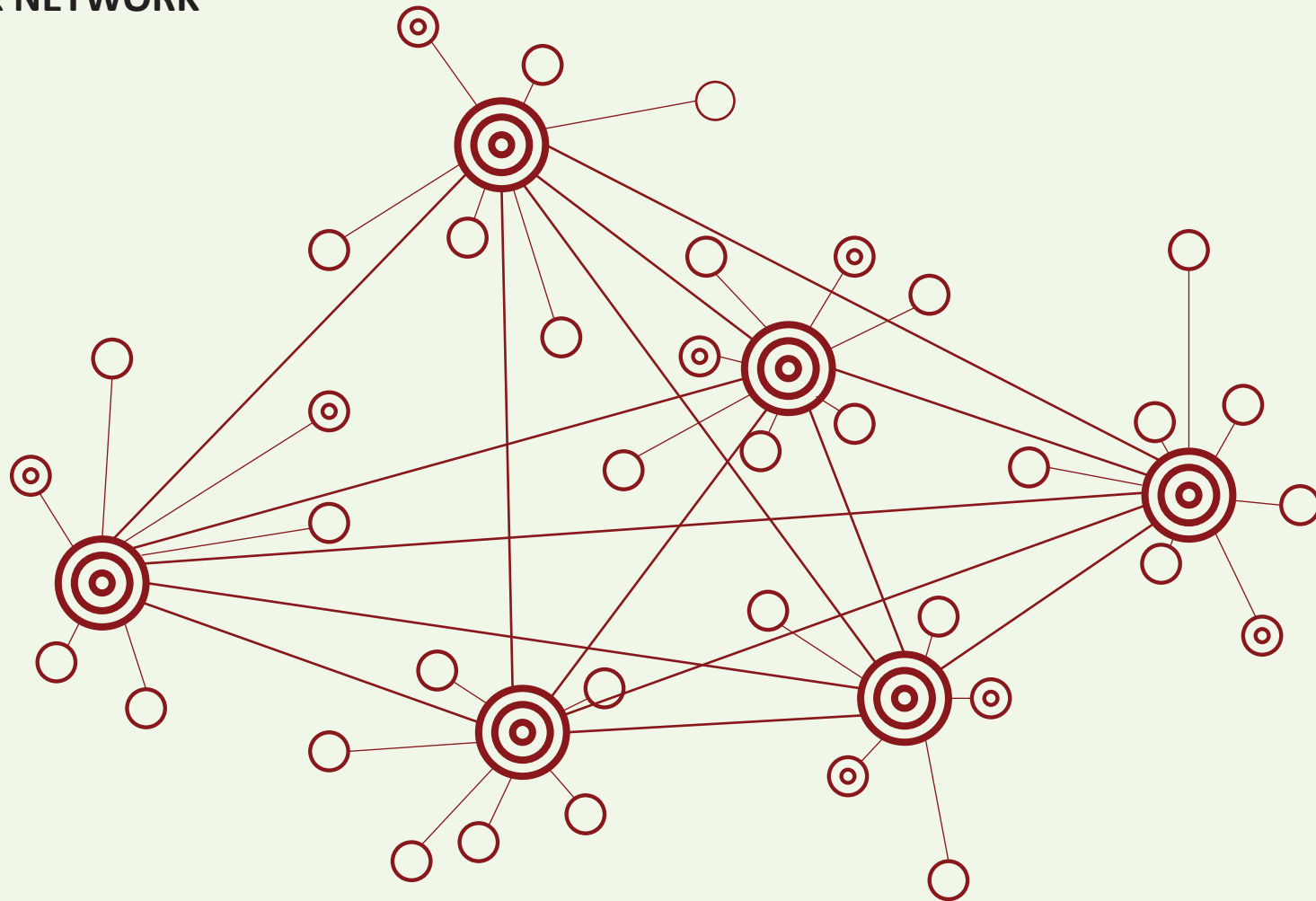
Climate change in the world has caused extinction of a lot of flora species.

According to scientists, **by 2070 the lowest temperature on the earth will be the highest that plants have ever experienced**; therefore, the chances of their survival is really low. Losing plant species will cause various tragic results, including starvation.

Seed banks are institutions created to conserve and preserve plants of the world. Researchers **register, study, conserve and reproduce** species of different plants; they want to make sure that the plants are able to survive the climate change and the ones which cannot be modified, are saved until the climate conditions go back to normal.




Because of various political, mechanical or economical reasons seed banks have failed in different countries, which resulted in losing the entire collection. By creating a **network of seed banks**, I would like to design a system which makes sure there is a **backup collection** in cases of failure; and later, by designing a prototype seed bank, I would like to propose a standard of the institutions, which can be used in different parts of the network. Modular system will allow the clients to construct the bank of a size appropriate to their needs.

SEED BANK NETWORK

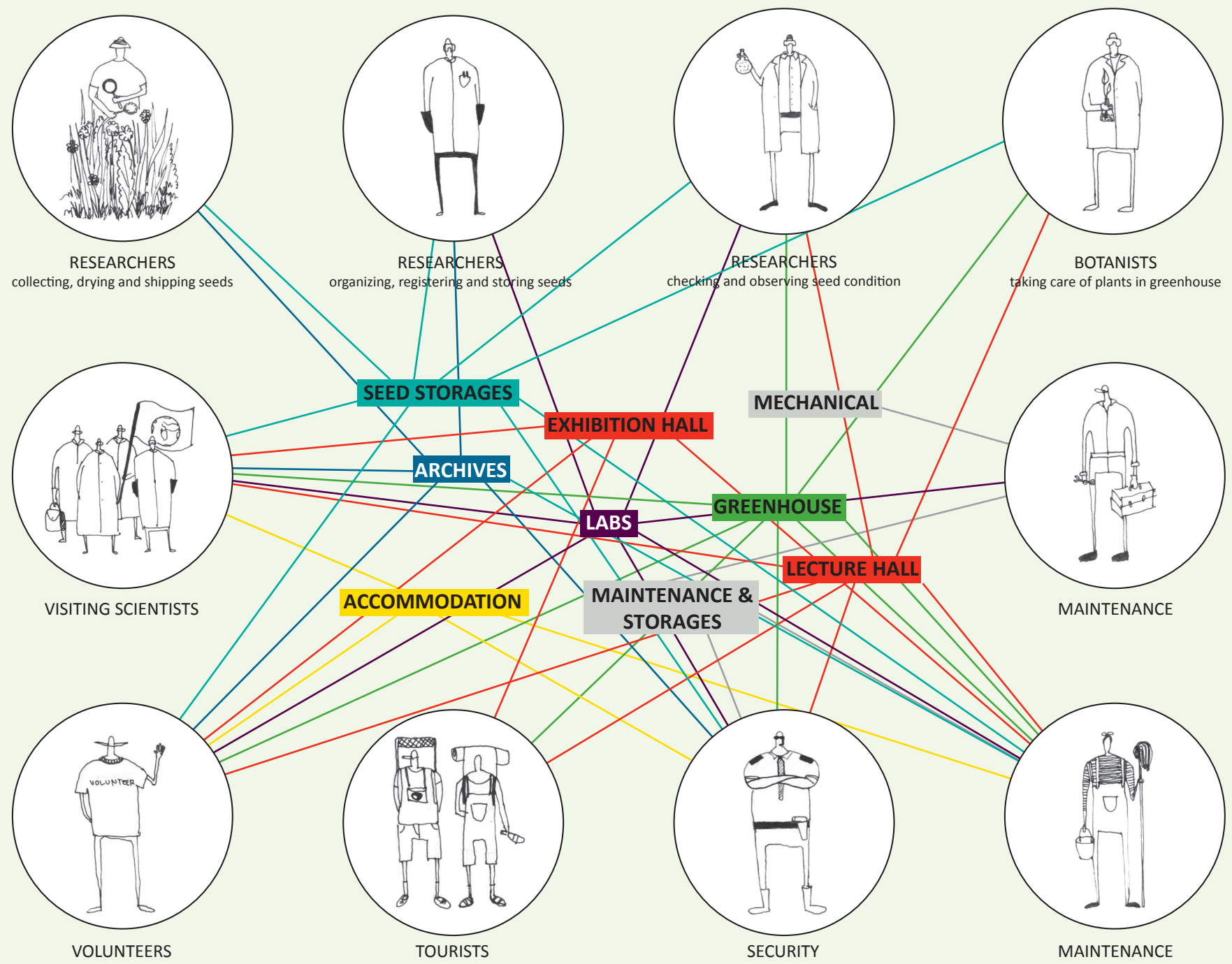


World floristic genetic information bank network will be spread throughout the world. The program will be distributed in the system of centers and sub-centers. Centers will be international, collecting seeds from different locations and acting as back-up system for sub-centers. They will contain educational and research facilities and will be large in scale, while sub-centers of regional or national meaning will contain only seed storages and green houses.

LEGEND

-  National seed bank. Program: seed storages.
-  Regional seed bank. Program: green houses, seed storages.
-  International seed bank. Program: research labs, conservation labs, archiving facilities, exhibition halls and lecture rooms, green houses, seed storages, archives, temporary accommodation facilities for scientists.

STAKEHOLDERS





CASE STUDIES



MILLENNIUM SEED BANK PROJECT

The largest seed bank of the world Millennium Seed Bank is an international conservation project and research center, a “living library” of over 3 billion seeds, which contains visitor center, as well as residential and educational science facilities.

PROJECT DATA:

Architect: Stanton Williams
 Client: The Royal Botanic Gardens Kew
 Location: Wakehurst Place, West Sussex, England
 Status: Completed 2000
 Budget: £14.0 m

The seed bank was formed to prevent extinction of plant species by storing their seeds and using them in future. Millennium Seed Bank has a global importance; the groups of scientists are responsible for conserving seeds from the entire world - by 2020 the seed bank plans to have species of flora representing 25% of global plant types. They study genetic information of species, take care of their germination tests of every sample in every 10 years, reproduce seeds and send back to their native lands to restore the natural habitat. The building is an interesting hybrid of public and private facilities: offices for scientists are mixed with public exhibition spaces, so that visitors could see how important plant studies are and be inspired by the research process. There are also completely isolated, underground zones with constant temperature and humidity level and the climate control is done very energy efficiently. I believe that studying that building will help me understand the process of plant conservation, spatial and technical needs and public involvement level for my project.



SVALBARD GLOBAL SEED VAULT

Svalbard Global Seed Vault is an **underground “backup system”** for the world agriculture located about 810 miles from the North Pole. The location allows scientists freeze seeds without mechanical assistance.

PROJECT DATA:

Architect: Peter W.Søderman
Client: The Global Crop Diversity Trust (GCDT)
Location: Longyearbyen, Svalbard, Norway
Status: Completed 2009

Seed banks located around the world are vulnerable due to construction, economical, mechanical or political reasons. Scientists decided to find a safe place on the world, remote from political interests, where they could conserve and preserve different crops' species without mechanical systems, so they chose Svalbard Island – the furthest undisturbed and uninhabited place which is still easy to reach by plane. Although this precedent was built purely for ecological reasons and has no public functions, I chose Svalbard Seed Vault because it is interesting for its natural processes and global politics. I also want to explore its storing strategies





EDEN PROJECT

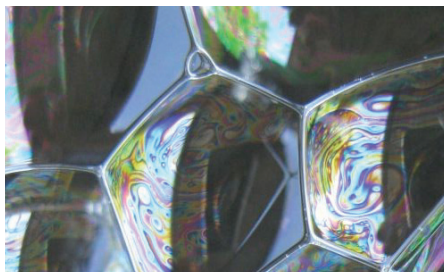
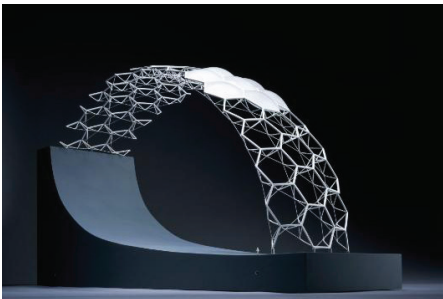
The largest plant enclosure, the Eden Project is a significant and innovative project for its structural solution, consisting of 8 inter-linked geodesic domes.

PROJECT DATA:

Architect:	Nicholas Grimshaw
Client:	The Eden Project LTD
Engineer:	Anthony Hunt and Associats
Pr. Manager:	Davis Langdon
Constructor:	Alfred McAlpine
Biome:	MERO
Location:	Cornwall, England
Status:	Completed 2001
Area:	23,000 m2
Budget:	£57-£75 m

The greenhouse, the shape of which is a beautiful biomimicry of inter-linked soap bubbles, is a home of thousands of species. Innovative use of thermoplastic ETFE allowed the engineers create biomes shaped with very light hexagonal panels, which can span much bigger than glass panels. I would like to research the project's mechanical and structural novelties and advanced technologies for the green house I plan to design for a prototype seed bank.

DESCRIPTION OF STRUCTIRE goes here



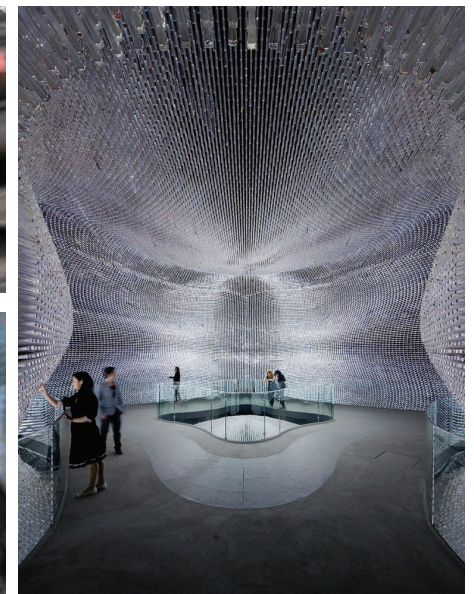
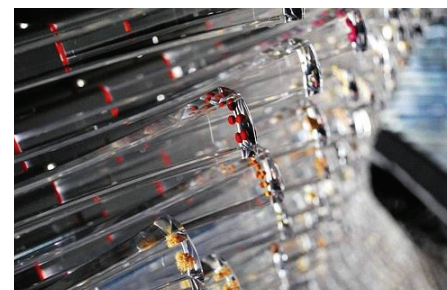
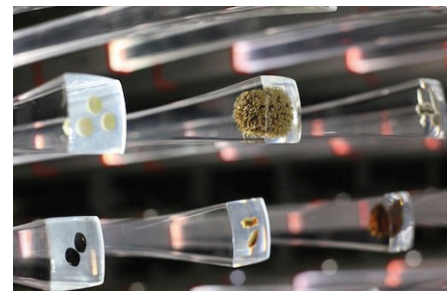
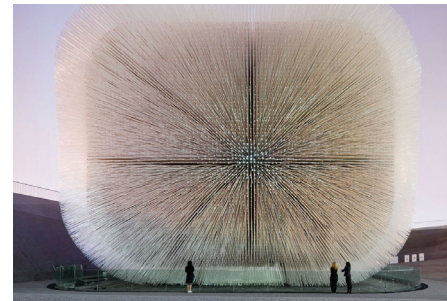
THE SEED CATHEDRAL

UK pavilion at Shanghai Expo is a beautiful representation of **British long traditions of botanical gardens.**

PROJECT DATA:

Architect: Heatherwick Studio
Client: Government of UK
Location: Shanghai, China
Status: Completed 2010
Area: 1,500 m²
Budget: £25 m

Significance of this project is in a different approach to plant presentation – in place of building a greenhouse, Heatherwick studio took seeds to define plants, to highlight how unique and beautiful the beginning of each plant can look like and turned seeds into the jewelry of the pavilion. I would like to research the pavilion as a successful and poetic example of plant exhibition.





INSTITUTE OF THE BOTANICAL GARDEN OF BARCELONA

Short Description:

PROJECT DATA:

Case Statement:

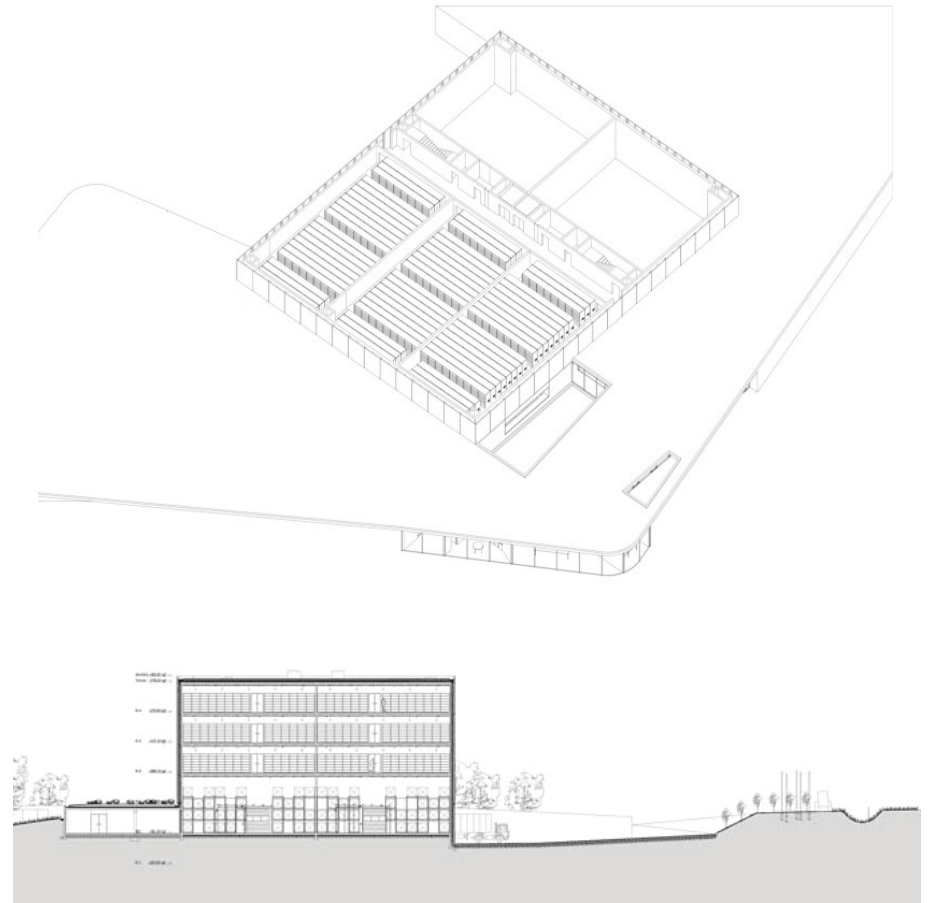
EDF ARCHIVES CENTER

Simple and elegant archive building in France **can store 70 kilometer of shelves** (43.5 miles) for paper-based and microfilm-based archived material providing maximum fire protection and constant temperature and humidity.

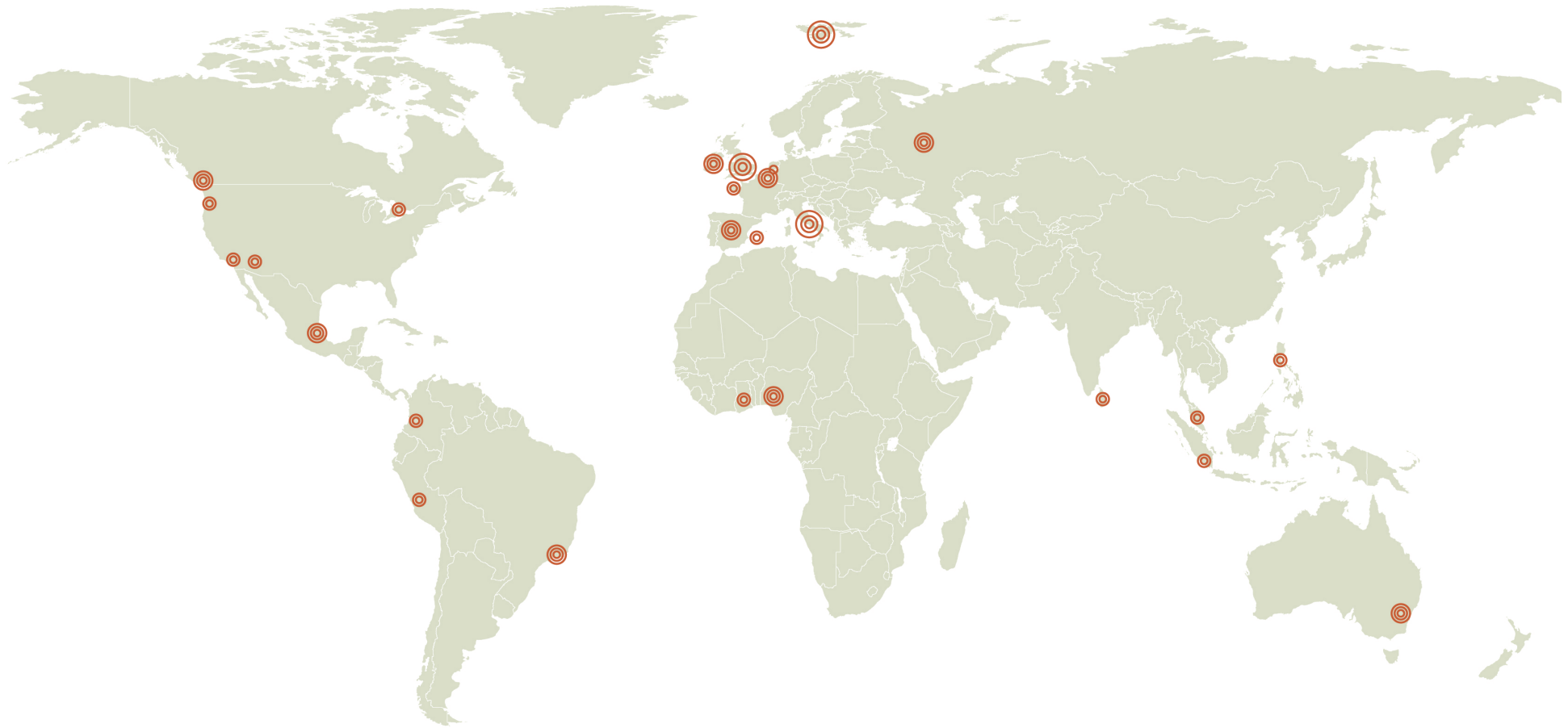
PROJECT DATA:

Architect: LAN Architecture
Client: EDF
Pr.Manager: Christophe Leblond
Location: Bure-Saurdon, France
Status: Completed 2008
Area: 6,800 m2

The reason why I got interested in the case is the storing strategies the architects chose – archives are composed by 20 similar storehouses on 5 floors; the design team worked on different floor heights to get the maximum out of the minimum amount of the built-up area. I would like to research how they hybridized storage spaces with offices, and study their plans and section drawings, as well as mechanical and fire protection systems.



EXISTING SEED BANKS



LEGEND

-  Taxonomic Seed Bank
-  Local Seed Bank
-  National Seed Bank
-  International Seed Bank

* ENSCONET - Regional seed bank,
coordinates seed activities in Europe

* Location of seed banks might not be accurate.

Sources:

- BGCI Plants of the Planet. *Seed Banks*. Resource Center. Botanic Garden Information. Web. <<http://www.bgci.org/resources/seedbanks/>>
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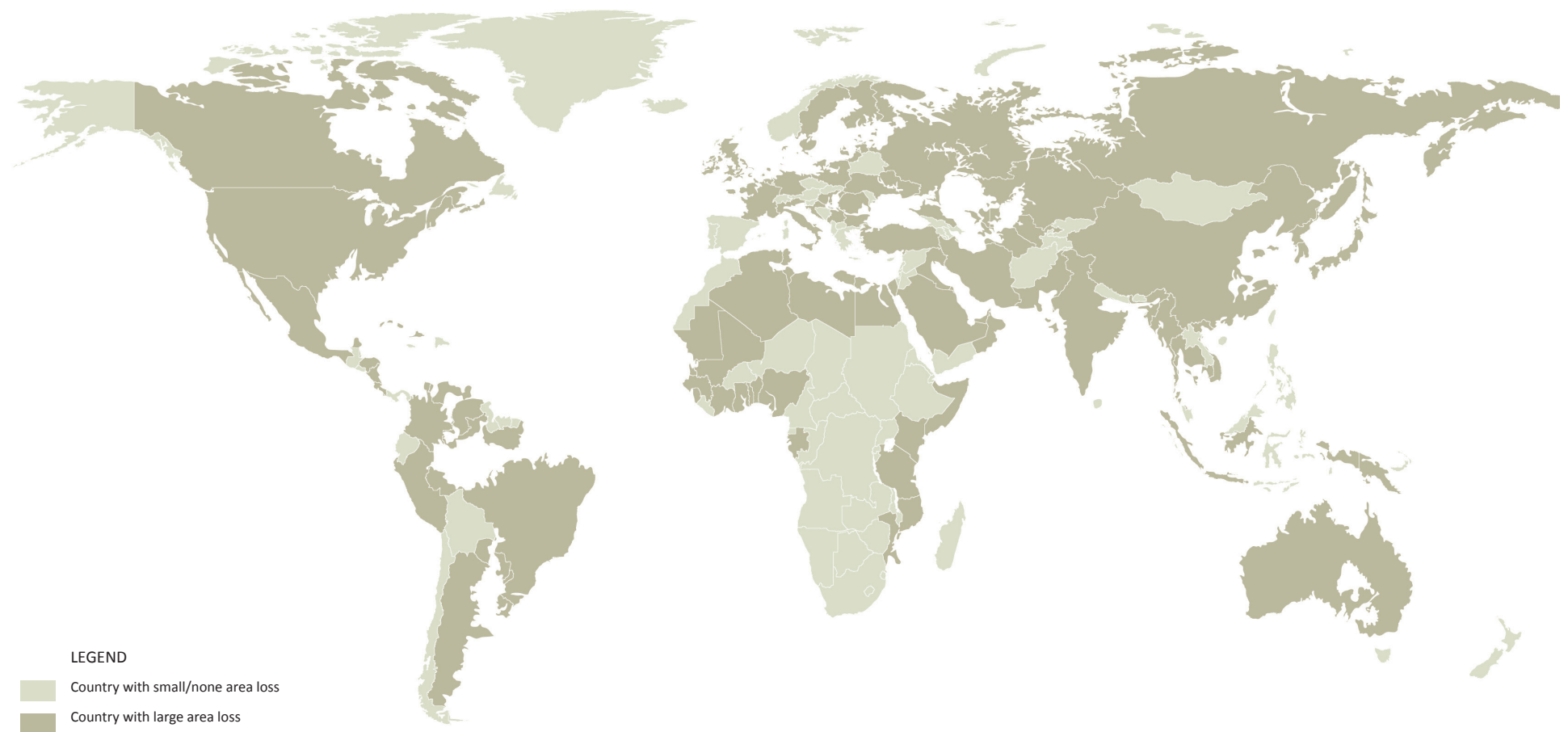
SITE

SITE SELECTION CRITERIAS:

1. GEOGRAPHICAL CHANGES

As mentioned before, scientists predict the **rise of water level by 7 to 23 inches** (18 to 59 centimeters) in the entire world. Since the seed banks are crucial for survival, I need to make sure to pick up flood-safe locations.

World Map 2050 - Flooding caused by the change of water level by 100 meters (328')

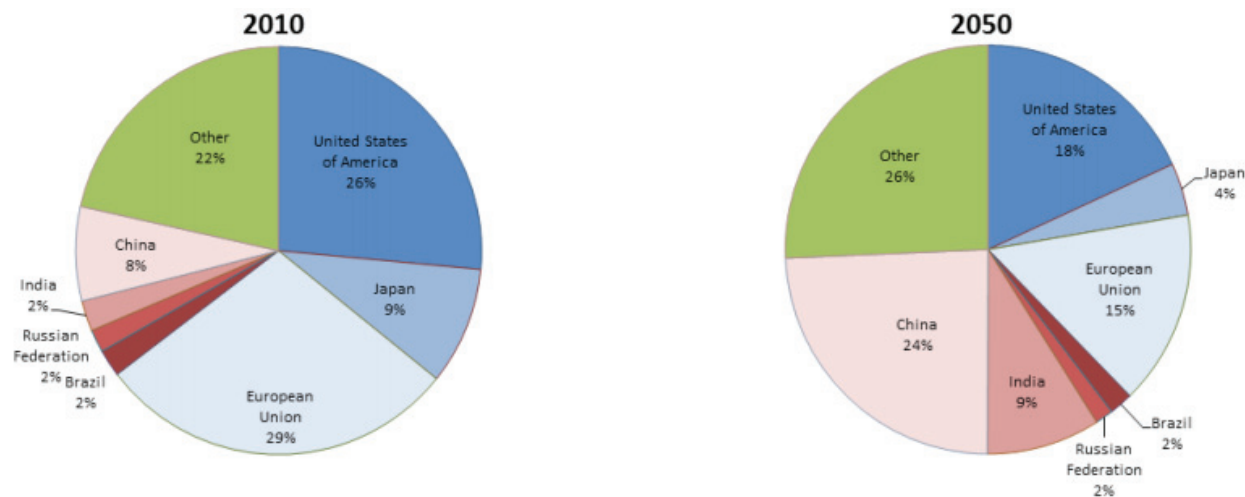


*Source: Buffalo Web. < <http://vrstudio.buffalo.edu/~depape/warming/World100-8190.jpg>>

2. ECONOMIC CONSISTENCY

According to the main-Board Trustee of Millenium Seed Bank Project Johnathan Drori, maintenance and research funds for Millennium Seed Bank is reaching ten million dollars annually. Maintaining the central buildings of the bank network will need a **strong economical background and consistency**, so the location is resulted by world GDP current projection and future predictions.

Regional shares of the world GDP in 2010 and 2050

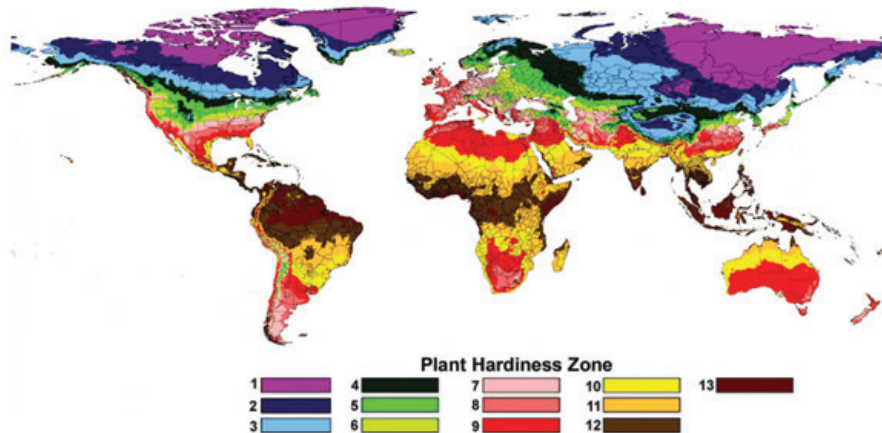


*Source: *Global Europe 2050. Executive Summary*. European Commission, European Research Area, Social Sciences and Humanities. Web. October 2011. <http://ec.europa.eu/research/social-sciences/pdf/global-europe-2050-summary-report_en.pdf>

3. FLORA DIVERSITY

While locating sub-centers, I need to find **home for each type of plant**, keeping in mind distances for transportation. Plant hardiness zones help me identify location needs regional centers, while plant diversity hotspots locate both national, and regional seed banks.

THIRTY-YEAR GLOBAL PLANT HARDINESS ZONE MAP FOR THE PERIOD 1978-2007



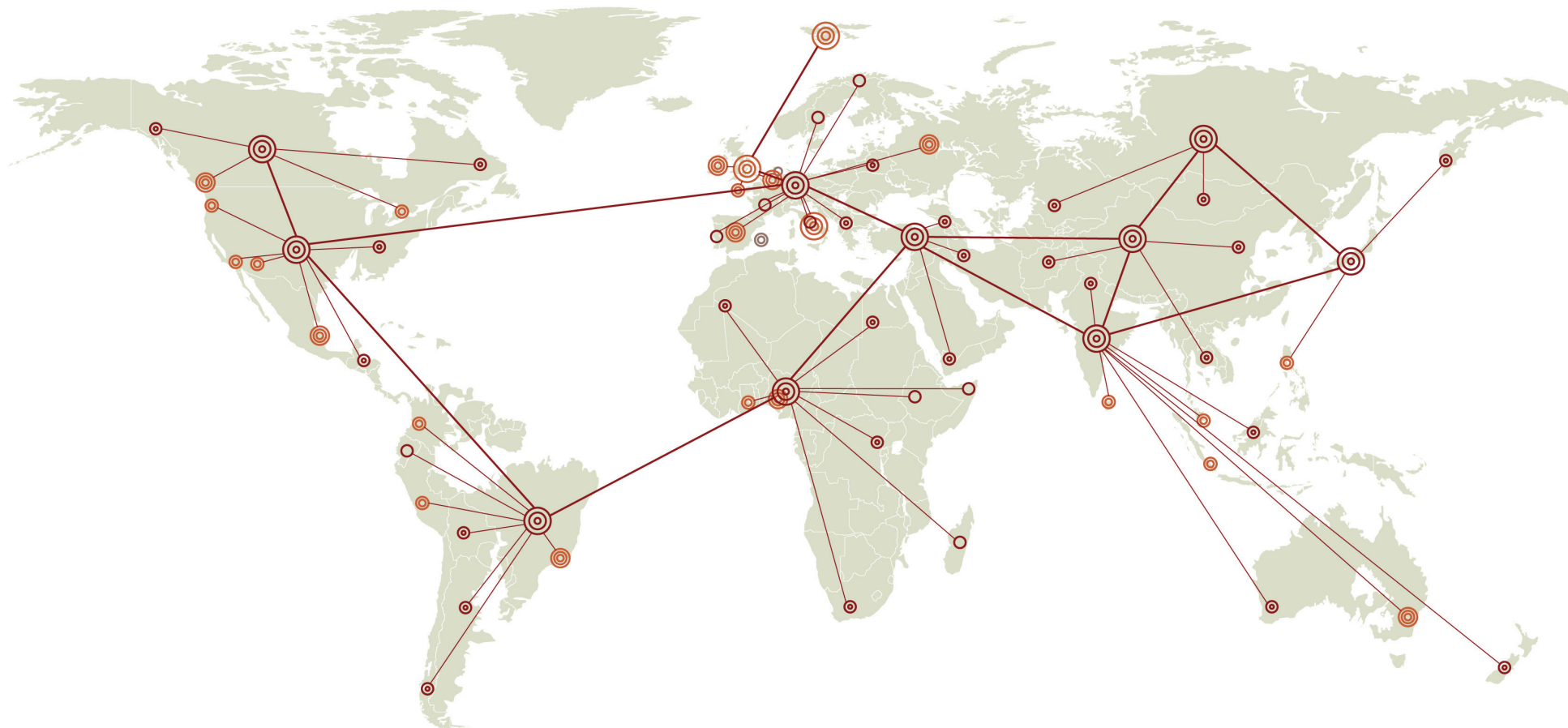
PLANT DIVERSITY HOTSPOTS












*Source:

- Scientia Agricola. *Global plant hardiness zones for phytosanitary risk analysis*. (Piracicaba, Braz.) vol.65 no.spe Piracicaba. Dec. 2008. Web. <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-90162008000700009>
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PROPOSED SEED BANK NETWORK



- LEGEND
- | | | |
|--|--|--|
|  Taxonomic Seed Bank |  Taxonomic Seed Bank with high chance to be flooded |  Proposed National Seed Bank |
|  Local Seed Bank |  National Seed Bank with high chance to be flooded |  Proposed Regional Seed Bank |
|  National Seed Bank | |  Proposed International Seed Bank |
|  International Seed Bank | | |



PROGRAM

PROGRAM

WORKSPACES	qty	net sq.ft	total net sq.ft	Notes
Administration Office	1	250	250	
Project Manager's Office	1	270	270	
Researcher's Office	12	150	1,800	
Meeting Room	1	270	270	

TOTAL SQ.FT 2,590

LABS	qty	net sq.ft	total net sq.ft	Notes
General Lab	2	600	1,200	
Seed Reception/quarantine	1	270	270	
Machinery Room	1	270	270	
Voucher Room (?)	1	300	300	
Incubator/Germination	1	1,600	1,600	
Thermo-gradients	1	270	270	
DNA Lab	1	900	900	
Centrifuge Room	1	65	65	
Freezer	1	65	65	-94° F (-70° C) temperature needed
Freezer	1	40	40	-94° F (-70° C) temperature needed
Clean Room	1	750	750	
Cleaning Room	1	600	600	
Washing Room	1	215	215	
Main Drying Room	1	1,300	1,300	
Dry Room	1	250	250	
Cold Room	1	65	65	
Preparation Room Ovens	1	300	300	
LN ² Room	1	65	65	
Agar Room	1	270	270	
Autoclave Room	1	230	230	Space for autoclave device for equipment sterilization
Balances	1	65	65	
Tissue Culture/Cryopreservation	1	185	185	
Chemical, Gas and LN ² Store	1	430	430	
Generator	1	270	270	
X-ray Room	1	750	750	
Store Room	1	350	350	
Dark Room	1	200	200	

TOTAL SQ.FT 11,275

DATA MANAGEMENT	qty	net sq.ft	total net sq.ft	Notes
Archive	1	230	230	
Data	1	180	180	
File Server	1	80	80	

TOTAL SQ.FT 490

PLANTS AND SEEDS	qty	net sq.ft	total net sq.ft	Notes
Seed Storage	3	1,300	3,900	-94° F (-70° C) temperature needed
Greenhouse	1	5,000	5,000	Needs a link to the labs
Potting Shed	1	750	750	

TOTAL SQ.FT 5,750

PUBLIC AWARENESS	qty	net sq.ft	total net sq.ft	Notes
Reception and Public display	1	270	270	
Exhibition Space	1	2,000	2,000	
Seminar Room	1	1,000	1,000	
Library	1	1,000	1,000	

TOTAL SQ.FT 4,270

ACCOMMODATION	qty	net sq.ft	total net sq.ft	Notes
Double Room	15	200	3,000	
Bathroom	15	45	675	
Lounge	1	400	400	
Canteen	1	700	700	

TOTAL SQ.FT 6,450

BUILDING SUPPORT	qty	net sq.ft	total net sq.ft	Notes
Restrooms	2	150	300	
Security Room	1	200	200	
Maintenance Room	1	45	45	
First Aid	1	100	100	
Storages	1	1,000	1,000	
Mechanical Rooms	1	2,500	2,500	

TOTAL SQ.FT 4,145

+ 10% circulation

TOTAL AREA 38,467

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